

DETAILED ACTION

1. This Office Action is in response to the Amendment filed 02/28/2008. Claims 8 and 11 were canceled and claims 1-7, 9-10, and 12-26 are now pending.

Allowable Subject Matter

2. Claims 1-7, 9-10, and 12-26 are allowed.

3. The following is an examiner's statement of reasons for allowance:

The present claims are allowable over the closest references: Wege et al. (US 6,420,491 B1), Hucul et al. (US 5,612,422), Zehner et al. (US 6,894,193 B2), Xu et al. [Southeastern Catalysis Society (Spring Symposium), April 13-14, 2003], Ross et al. (GB 2 374 071 A), and Poliakoff et al. (WO 97/38955).

Summary of claim 1:

A method of hydrogenating a polymer, comprising the steps of:	
A	providing a dense phase, the dense phase comprising a polymer in an organic solvent;
B	providing a catalyst system, the catalyst system comprising at least one metal hydrogenation catalyst selected from the group consisting of nickel and ruthenium immobilized on a solid support; and
C	providing a light phase,

	the light phase comprising hydrogen and <u>supercritical carbon dioxide</u> ; and
D	contacting the dense phase, the light phase, and the catalyst system so that the hydrogen reacts with the polymer and the polymer is hydrogenated

Summary of claim 19:

A method of hydrogenating a polymer, comprising the steps of:	
A	providing a liquid dense phase, the dense phase consisting essentially of a polymer in an organic solvent: the polymer selected from the group consisting of polystyrene, poly(bisphenol A carbonate), poly(ethylene terephthalate), polybutadiene and copolymers thereof, and polyisoprene and copolymers thereof; the solvent included in the dense phase in an amount of from 0.1 to 20 wt%
B	providing a solid catalyst system, the catalyst system comprising at least one metal hydrogenation catalyst selected from the group consisting of nickel and ruthenium immobilized on a solid support; and
C	providing a light phase, the light phase consisting essentially of hydrogen at a pressure of 100 to 2000 psi and <u>supercritical carbon dioxide</u> ; and
D	contacting the dense phase, the light phase, and the catalyst system at a temperature of 50 to 300°C, and in an amount of 0.1 to 1 weight of catalyst system per weight of polymer, to react hydrogen with the polymer and the polymer is hydrogenated.

Wege et al. disclose a process to hydrogenate an aromatic polymer in (A) a solvent comprising (i) a hydrocarbon selected from at least one of a cycloaliphatic hydrocarbon and an aliphatic hydrocarbon and (ii) at least one oxygen-containing

hydrocarbon in the presence of (B) a catalyst comprising (i) a support comprising at least one of silicon dioxide and aluminum oxide and (ii) at least one metal of sub-group VIII of the periodic table of the elements, wherein the aromatic polymer can be polystyrene and the metal of sub-group VIII of the periodic table of the elements is nickel (col. 2, lines 58-59; col. 3, lines 30-42 and 65-67; col. 4, lines 1-7; col. 5, lines 53-55; claim 1). However, Wege et al. do not teach or fairly suggest the claimed method to hydrogenate a polymer, wherein the hydrogenation is carried out in the presence of a combination of hydrogen and supercritical carbon dioxide.

Hucul et al. disclose a process to hydrogenate an aromatic polymer, comprising contacting the aromatic polymer with a hydrogenating agent in the presence of a silica supported metal hydrogenation catalyst at a temperature between about 50 to about 250°C such that at least 80 percent aromatic hydrogenation is achieved, wherein the hydrogenating agent can be hydrogen; the metal can be nickel or ruthenium; and the aromatic polymer can be polystyrene (claims 1, 3-4, and 12-13). However, Hucul et al. do not teach or fairly suggest the claimed method to hydrogenate a polymer, wherein the hydrogenation is carried out in the presence of a combination of hydrogen and supercritical carbon dioxide.

Zehner et al. disclose a process to hydrogenate liquid organic compounds in the presence of a mixture of the hydrogen used for the hydrogenation with proportions of at least one gas which is inert in the hydrogenation reaction to achieve an optimum mass transfer between the hydrogen and the hydrogenation bath takes place, which results in suppressing the aging of the catalyst and increasing the selectivity of the reaction,

wherein the inert gas can be carbon dioxide (col. 2, lines 1-18 and 39-56). However, Zehner et al. do not teach or fairly suggest the claimed method to hydrogenate a polymer, wherein the hydrogenation is carried out in the presence of a combination of hydrogen and supercritical carbon dioxide.

Xu et al. disclose a process to hydrogenate polystyrene in decahydro naphthalene in the presence of hydrogen and CO₂ under supercritical conditions, using Pd/BaSO₄ as a catalyst, wherein the supercritical CO₂ reduces the viscosity of polymer solution to enhance hydrogen transport from the gas into the polystyrene solution (summary). However, the published date is later than the priority date.

Ross et al. disclose a continuous process to hydrogenate a substrate in the presence of a supercritical fluid, wherein the substrate is “alkene, alkyne, lactone...and ketal” and the supercritical fluid can be carbon dioxide (abstract; claims 1-4). However, Ross et al. do not teach or fairly suggest the claimed process to hydrogenate a polymer, wherein the hydrogenation is carried out in the presence of a combination of hydrogen and supercritical carbon dioxide.

Poliakoff et al. disclose a process to hydrogenate an aliphatic or aromatic substrate under supercritical or near critical conditions, wherein the supercritical fluid can be carbon dioxide (claims 1 and 9). However, Poliakoff et al. do not teach or fairly suggest the claimed process to hydrogenate a polymer, wherein the hydrogenation is carried out in the presence of a combination of hydrogen and supercritical carbon dioxide.

In light of the above discussion, it is evident as to why the present claims are patentable over the prior art.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ling-Siu Choi whose telephone number is 571-272-1098.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu, can be reached on 571-272-1114.

/Ling-Siu Choi/

Primary Examiner, Art Unit 1796

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